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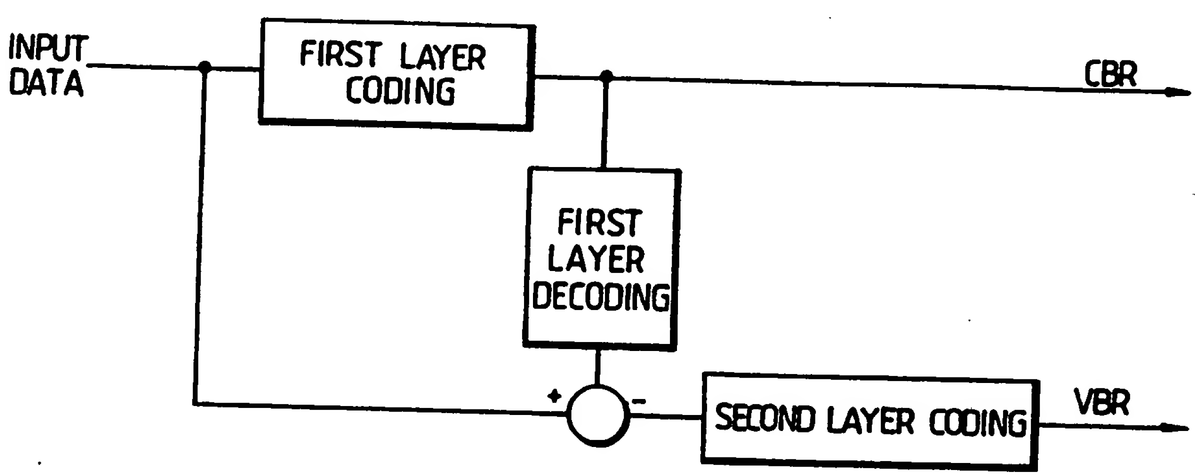
(54) Title: SIGNAL CODING



(57) Abstract

A method of coding a video signal for transmission is described which comprises coding data representing the video signal by a base layer coding operation which includes base layer quantizer having a base layer quantization step size to provide coded video data for transmission; deriving inverse-coded video data by carrying out an inverse base layer coding operation on the coded video data; deriving difference data from the data representing the video signal and the inverse coded video data; and coding the difference data by an enhancement layer coding operation only when the energy of the difference data exceeds a variable threshold, the threshold being inversely proportional to the base layer quantization step size.

SIGNAL CODING

The present invention relates to the coding of video signals.

Techniques are well known for coding digitised video signals to achieve data compression and thereby reduce the bit rate required to transmit the coded video signals. An example of such a technique is the CCITT recommendation H.261 Video Coding Standard which employs spatial and temporal redundancies in a video coding process to achieve data compression. Such redundancies vary with picture content and hence the level of data compression and the resultant required bit rate also vary. To facilitate operation with fixed or constant bit rate transmission channels buffering of the coded video data takes place. However this buffering is insufficient to cope with large and rapid variations in data rate as experienced, for example, with a scene change or as a result of motion in the picture. In such circumstances parameters of the coding process are adjusted to reduce the coded data rate. There is, however, a resultant reduction in picture quality. One form of parameter control involves adjusting the step size of the quantisation stage of the coding process in relation to the fullness of the buffer. The overall result is that for fixed rate transmission channels the picture quality is variable, with coding distortions being particularly visible at some times where at other times channel capacity may be wasted because there are few changes to be transmitted.

The prospect of asynchronous transfer mode (ATM) networks such as broadband ISDN, CCITT recommendation I121, offers the possibility of variable bit rate transmission channels with potential benefits for the type of video coding just described. A first approach might be to dispense with the buffering of the coded video data and to exploit the variable bit rate channel of an ATM network to cope with the variable coded data rate of the video transmission. However, ATM networks, which will commonly be packet or cell based, are

quantizer having a base layer quantization step size to provide coded video data for transmission;

deriving inverse-coded video data by carrying out an inverse base layer coding operation on the coded video data;

deriving difference data from the data representing the video signal and the inverse coded video data; and

coding the difference data by an enhancement layer coding operation only when the energy of the difference data exceeds a variable threshold, the threshold being inversely proportional to the base layer quantization step size.

A preferred embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, wherein:

Figure 1 is a schematic diagram of a two layer video coding process;

Figure 2 is a schematic diagram of an H.261 video encoder modified in accordance with an embodiment of the invention;

Figure 3 is a schematic diagram of an H.261 video decoder modified in accordance with an embodiment of the invention; and

Figure 4 is a graph illustrating the reduced SKR obtainable with the present invention.

Referring generally to Figures 2 and 3, an embodiment of the invention will be described as a modification to the CCITT H.261 coding process as exemplified by the video encoder and decoder of Figures 2 and 3, respectively, the invention is applicable to other coding schemes and the H.261 standard is chosen to illustrate the principles of the embodiments of the invention, and is not chosen by way of limitation. The parts of the embodiment of the invention illustrated in Figures 2 and 3 corresponding to the H.261 standard are shown contained within broken line boxes. As these parts of the encoder and decoder are well known they will not be described in detail.

Referring first to Figure 2 encoding of video input data takes place according to the H.261 standard to provide a base layer of coded video data for transmission over a CBR channel. From the H.261 coding process the coded data after

information, and line interface (LI) to a VBR channel, of for example an ATM network.

The process just described results in data for blocks of variable difference data having an energy greater than the threshold level being coded and transmitted over the VBR channel. Thus, blocks with significant changes in them are transmitted whereas blocks with smaller changes are not. Figure 4 is a graph showing the comparison of SWR for blocks greater than the variable threshold in the second layer to no decision on blocks in the second layer. The mean bit rate for the second layer has dropped to 31315bits/s a saving of 33% on the 2-layer model without any thresholding. The mean SNR has dropped to 39.93dBs (a drop of 0.34dBs) the spread is 1.4dBs.

Data for blocks with instantaneous energy levels below the threshold level will not be transmitted and thus small changes, for example in background detail, may not ever be transmitted as enhancement data. Such small changes may occur at a low rate and gradually an error may build between the "true" image and that encoded and transmitted.

To overcome this problem the step size of the quantiser (Q) of the H.261 encoder is fixed to the same step size as the quantiser in the enhancement layer encoder for part of each frame of an input video image. Thus, an image is notionally divided into 12 groups of blocks (GOBs) and over a sequence of frames the quantiser of the H.261 encoder be set to the fixed step size of the enhancement coder quantiser for each of the GOBs in turn. This results in the coding in the base layer of more data than usual for the GOB selected in a particular frame, and no data will be encoded in the enhancement layer because the threshold level of the enhancement coder will become very high, while at the same time the energy of the variable difference data of the selected GOB will be low. With the quantiser in the H.261 coder having a small step size the quantisation errors will be small and the errors will be less than their quantiser step size in the enhancement layer. The result will be a fall in the instantaneous coded data rate in the enhancement layer and an increase in the instantaneous coded data rate in the base layer, though of course because of

CLAIMS

1. A method of coding a video signal for transmission, comprising:

coding data representing the video signal by a base layer coding operation which includes base layer quantizer having a base layer quantization step size to provide coded video data for transmission;

deriving inverse-coded video data by carrying out an inverse base layer coding operation on the coded video data;

deriving difference data from the data representing the video signal and the inverse coded video data; and

coding the difference data by an enhancement layer coding operation only when the energy of the difference data exceeds a variable threshold, the threshold being inversely proportional to the base layer quantization step size.

2. A method as claimed in claim 1 in which the enhancement layer coding operation includes quantisation.

3. A method as claimed in claim 2 in which the base layer includes quantisation step size is selectively set to be the same as the enhancement layer quantisation step size for data representing a part of an image of the video signal.

4. A method as claimed in claim 3 in which the image is notionally divided into a series of sections and for each image of the video signal data, one of the sections of the image is processed with the quantisation step size of the base layer coding operation set be the same as the enhancement layer quantisation step.

5. A method as claimed in any preceding claim in which the data representing the video signal is itself a coded representation of the video signal.

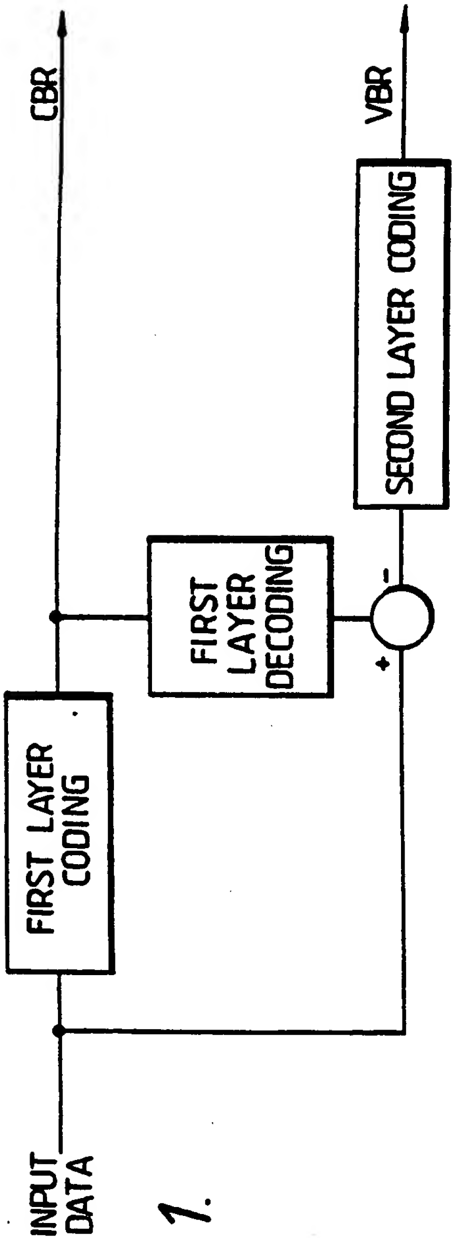

INPUT DATA
FIRST LAYER CODING
CBR
FIRST LAYER DECODING
+
-
SECOND LAYER CODING
VBR

Fig. 1.

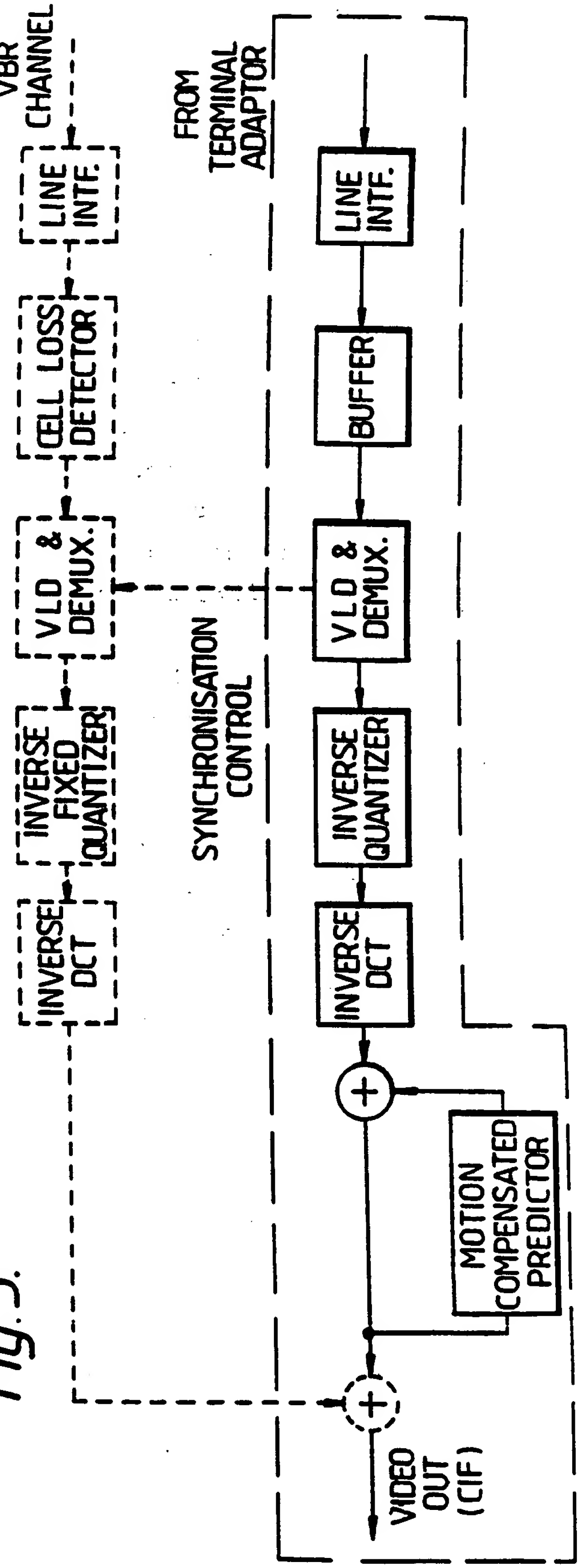
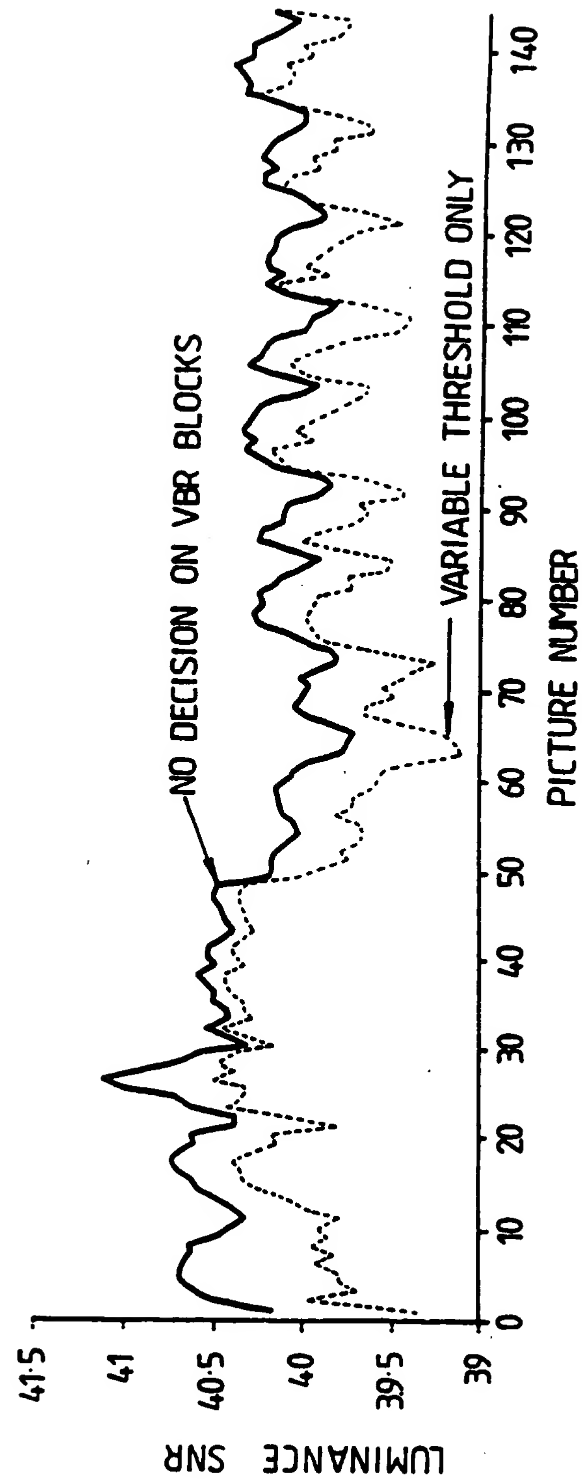

VBR CHANNEL
LINE INTF.
CELL LOSS DETECTOR
VLD & DEMUX.
INVERSE FIXED QUANTIZER
INVERSE DCT
SYNCHRONISATION CONTROL
FROM TERMINAL ADAPTOR
LINE INTF.
BUFFER
VLD & DEMUX.
INVERSE QUANTIZER
INVERSE DCT
+
MOTION COMPENSATED PREDICTOR
+
VIDEO OUT (CIF)

Fig. 3.

Fig. 4.

SIGNAL TO NOISE PROFILE OF JACK IN THE BOX SIMULATION SEQUENCE



International Application No PCT/GB 91/01788

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	IEEE Journal on Selected Areas in Communications, vol. 7, no. 5, June 1989, IEEE, M. Ghanbari: "Two-layer coding of video signals for VBR networks", pages 771-781, see page 771, right-hand column, lines 4-41; page 772, right-hand column, lines 29-46; figure 1 (cited in the application) ---	1,7
A	US,A,4541012 (A.G. TESCHER) 10 September 1985, see column 6, lines 3-28 ---	1
A	IEEE Trans. on Communications, vol. 37, no. 4, April 1989, New York (US) Sheau-Bao NG et al.: "Two-tier DPCM codec for videoconferencing", pages 380-386 -----	1